AG

PATENT SPECIFICATION

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763,359

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Index at acceptance:—**Class 51(1)**, A1B1A.

COMPLETE SPECIFICATION

Combustion Chambers for Jet Propulsion Engines, Gas Turbines or other Apparatus

We, JOSEPH LUCAS (INDUSTRIES) LIMITED, of Great King Street, in the City of Birmingham, 19, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to liquid fuel combustion chambers for jet-propulsion engines, gas turbines, or for other purposes such as air heaters, of the cylindrical or annular type and having an air jacket to which air is supplied by a blower.

The object of the invention is to provide improved means for imparting to the air admitted to the combustion chamber, a swirling motion for providing intimate mixture of the fuel and air.

The invention comprises the combination with a nose piece extending from the entrance end of the combustion chamber, of an air duct terminating in a vortex chamber, the latter having at one side an outlet through which the air passes to the combustion chamber.

In the accompanying drawings, Figure 1 is a sectional side elevation illustrating diagrammatically a portion of a combustion chamber of annular form provided with the invention.

Figure 2 is a sectional end view, the portion shown in the upper part of Figure 2 being taken on the line 1—1, and the lower portion on the line 2—2, of Figure 1.

Figure 3 is a fragmentary sectional side elevation drawn to a larger scale than Figures 1 and 2 and illustrating more clearly the part forming the subject of the invention.

Figure 4 is a sectional side elevation illustrating one application of the invention to a cylindrical combustion chamber, and Figure 5 is a cross section on the line 4—4 of Figure 4. Figure 6 is a similar view to Figure 4 illustrating another embodiment of the invention as applied to a cylindrical combustion chamber.

Referring to Figures 1—3, an annular combustion chamber *a* is constructed in conventional form from sheet metal and comprises inner and outer walls of substantially cylindrical shape, these walls being surrounded by inner and outer air jackets *b*, *c* having a common entrance at *d* to which air is supplied by a blower. At its entrance end the combustion chamber is closed by an assembly of contiguous and dished sheet metal segments *e*, each of which at its centre is provided with a fuel nozzle *f*. From the said end of the combustion chamber extends towards the entrance of the air jacket a hollow sheet metal nose piece *g* of annular form and tapering section adapted to divert air to the inner and outer air jackets. In the nose piece are contained a plurality of air ducts *h*, each adapted to gather from the air stream flowing past the nose piece to the inner air jacket the quantity of air required to be discharged around each nozzle, and each duct is shaped to merge into a vortex chamber *i*, surrounding the nozzle and of gradually diminishing cross section, the said chamber having a circular outlet *j* adjacent to the discharge end of the fuel nozzle.

The arrangement is such that air gathered by each duct is conveyed to its associated vortex chamber where a rotary motion is imparted to the air, and the swirling air on passing through the outlet immediately forms with the fuel spray emerging from the nozzle an intimate fuel-air mixture in the combustion zone adjacent to the nozzles.

In a modification of the above described arrangement, the inner end of the combustion,

chamber is formed by two or more concentric rings of the segments *e*. Further, instead of arranging each of the fuel nozzles within a vortex chamber as above described, the said nozzles may be arranged with the combustion chamber so that the fuel is directed upstream towards the outlet of the associated vortex chamber. Also instead of nozzles adapted to discharge the fuel in the form of spray, they may be combined with vaporisers for discharging the fuel in a gaseous condition.

In the application of the invention to a combustion chamber of cylindrical form, a vortex chamber as above described, may be mounted on the axis of the closed end of the combustion chamber, but preferably an arrangement such as shown in Figures 4—6 is employed.

Referring to Figures 4 and 5, the combustion chamber *a* which is surrounded by an air jacket *b* is provided with a coaxial tubular air duct *m* which extends through the nose piece *g* and terminates in an annular outlet passage *n*. In the closed end of the combustion chamber are arranged a group of (for example) four vortex chambers *i* all of which are supplied from the passage *n*, and each votex chamber is provided with an outlet *j*. The fuel nozzles *f* are arranged as shown. Also in this example the nose piece is so constructed as to form an annular additional air passage *o* for conveying secondary air to the combustion chamber.

An alternative arrangement of the fuel nozzles is shown in Figure 6. In this example, the nozzles are contained in the combustion chamber and are combined with a vaporiser *p*, the fuel being conveyed to the vaporiser by a tube *q*, concentric with the air duct *m*.

What we claim is: —

1. In a liquid fuel combustion chamber of the type specified, the combination with a nose piece extending from the entrance end of the said chamber, of an air duct terminating in a vortex chamber, the latter having at one side an outlet through which air passes to the combustion chamber, and a fuel nozzle contained either within the vortex chamber or the combustion chamber coaxially with the said outlet.

2. In a liquid fuel combustion chamber of the type specified, the combination with a nose piece extending from the entrance end of the said chamber, of a plurality of vortex chambers each having at one side an outlet through which air passes to the combustion chamber, and either a separate duct for conveying air to each vortex chamber, or a common duct for conveying air to all the vortex chambers, and a fuel nozzle arranged coaxially with the outlet of each vortex chamber, the nozzles being contained within either the vortex chambers or the combustion chamber.

3. A liquid fuel combustion chamber having combined with it a plurality of air vortex chambers and associated fuel nozzles, substantially as described with reference to Figures 1—3, 4 and 5, or Figure 6 of the accompanying drawings.

MARKS & CLERK.

PROVISIONAL SPECIFICATION
No. 1807 A.D. 1954

Combustion Chambers for Jet Propulsion Engines, Gas Turbines or other Apparatus

We, JOSEPH LUCAS (INDUSTRIES) LIMITED, of Great King Street, in the City of Birmingham, 19, a British Company, do hereby declare this invention to be described in the following statement: —

This invention relates to liquid fuel combustion chambers for jet propulsion engines, gas turbines, or for other purposes such as air heaters of the cylindrical type having a centrally arranged fuel nozzle in the entrance end of the chamber, or of the annular type in which the entrance end of the chamber is closed by a plurality of segmental pieces each carrying a centrally arranged fuel nozzle, the chamber being surrounded by the inner and outer walls of an air jacket to which air is supplied by a blower.

The object of the invention is to enable in a convenient manner the fuel jet to be surrounded by a swirling air stream for promoting intimate mixture of the fuel and air in the combustion zone adjacent to the nozzles.

The invention comprises the combination with a nose piece extending from the entrance end of the combustion chamber, of an air duct leading to a nozzle and terminating in a vortex chamber surrounding the nozzle, the said chamber having an annular outlet adjacent to the discharge end of the nozzle.

In one example, an annular combustion chamber is constructed in conventional form from sheet metal and comprises inner and outer walls of substantially cylindrical shape, these walls being surrounded by inner and outer air jackets having a common entrance to which air is supplied by a blower. At its entrance end the combustion chamber is closed by an assembly of contiguous and dished sheet metal segments each of which at its centre is adapted to carry a fuel nozzle. From the said end of the combustion chamber extends

towards the entrance of the air jacket a hollow sheet metal nose piece of annular form and tapering section adapted to divert air to the inner and outer air jackets. In the nose piece are contained a plurality of air ducts, each adapted to gather from the air stream flowing over the nose piece to the inner air jacket the quantity of air required to be discharged around each jet, and each duct is shaped to merge into a vortex chamber surrounding the nozzle and of gradually diminishing cross section, the said chamber having an annular outlet adjacent to the discharge end of the nozzle.

The arrangement is such that air gathered by each duct is conveyed to its associated vortex chamber where a rotary motion is imparted to the air, and the swirling air on passing through the outlet immediately forms with the fuel spray emerging from the nozzle an intimate fuel-air mixture in the combustion zone adjacent to the nozzles.

The invention is applicable in an essentially similar manner to combustion chambers of cylindrical form.

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PROVISIONAL SPECIFICATION
No. 9550 A.D. 1954

Combustion Chambers for Jet Propulsion Engines, Gas Turbines or other Apparatus

We, JOSEPH LUCAS (INDUSTRIES) LIMITED, of Great King Street, in the City of Birmingham, 19, a British Company, do hereby declare this invention to be described in the following statement: —

This invention relates to liquid fuel combustion chambers for jet-propulsion engines, gas turbines, or other apparatus such as air heaters or industrial furnaces, the chambers being of either the annular or the cylindrical type surrounded by an air jacket, which is supplied by a blower.

In the Provisional Specification of our concurrent Application for Patent No. 1807 of 1954, we have described an invention whereby the air is supplied in a swirling condition for promoting intimate mixture of the air and fuel.

In the form described in the said Specification, the invention comprises an air duct leading to a fuel nozzle and terminating in a vortex chamber surrounding the nozzle, the said chamber having an annular outlet adjacent to the discharge end of the nozzle.

In the further development of the said invention certain modifications have been devised which are hereinafter described.

Instead of arranged the fuel oil nozzle within the vortex air chamber, it may be arranged in a coaxial position at a distance from the vortex chamber. In this arrangement the nozzle discharges the fuel towards the vortex chamber. Further the nozzle may be of the kind which discharges the fuel in the form of a swirling spray, or it may form the discharge end of a fuel vaporiser, in which case the fuel is discharged in the gaseous condition.

In our previous Specification above mentioned we have described an annular combustion chamber construction in which the inner end of the combustion chamber is closed by an assembly of contiguous and dished metal segments, and in combination with each segment is arranged an air vortex chamber.

In a modification of this construction the inner end of the combustion chamber is formed by a pair of concentric rings of sectors, the sectors in each ring being spaced apart and interconnected by short necks. In each sector is formed a central hole which surrounds a burner nozzle, and at the rear side of each sector is mounted an air vortex chamber which receives air tangentially from a common supply duct and from which the air flows through the said hole.

Alternatively, the inner end of the combustion chamber may be constructed to accommodate groups of vortex chambers, each group including any desired number of such chambers, and each such chamber having associated with a fuel nozzle situated within it, or located at a distance from it, as above described.

In a modified form of our invention as applied to a cylindrical combustion chamber, the inner end of the combustion chamber is provided with any desired number of air vortex chambers (for example, four), these being spaced at equal angular distances apart around the central axis of the combustion chamber, and each vortex chamber has associated with it a fuel nozzle. When the fuel is supplied through a vaporiser, this may include an axial feed pipe terminating at one end in a chamber from which extend connections to pipes situated coaxially with, and arranged to discharge the fuel towards, the vortex chambers.

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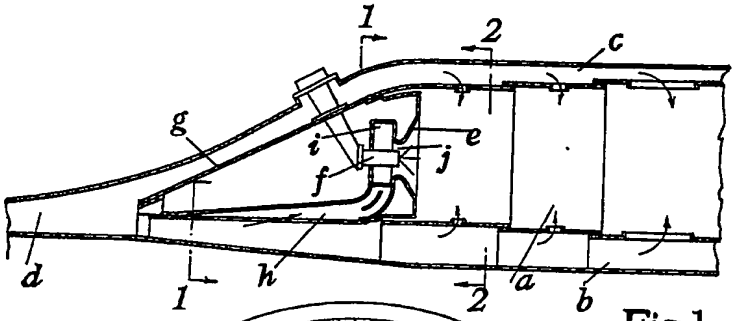

Fig.1

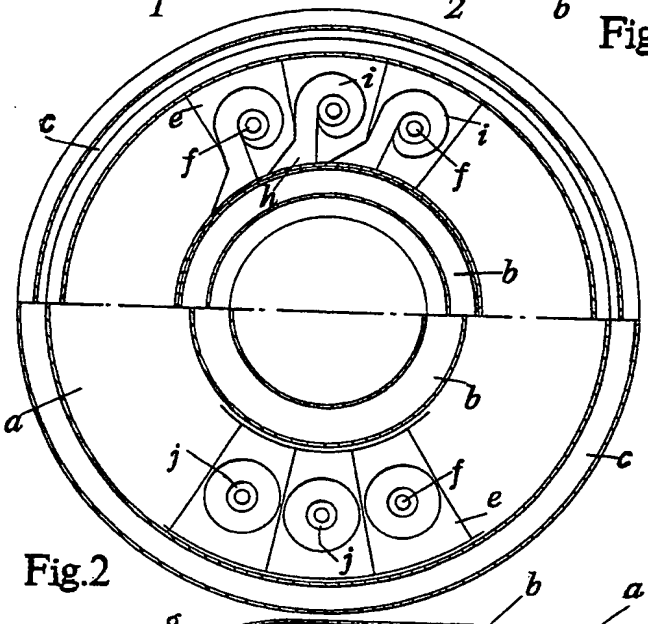

Fig.2

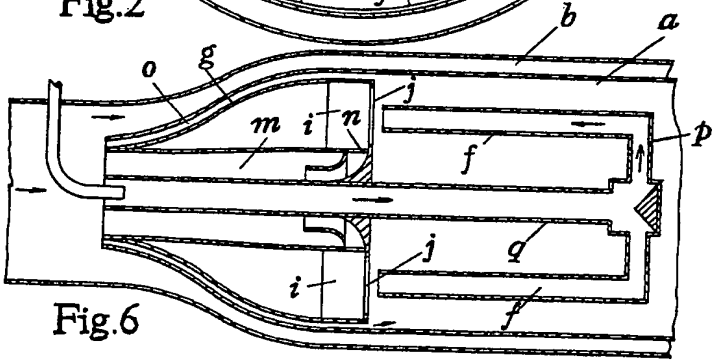

Fig.6

763359 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale Sheets 1 & 2*

1

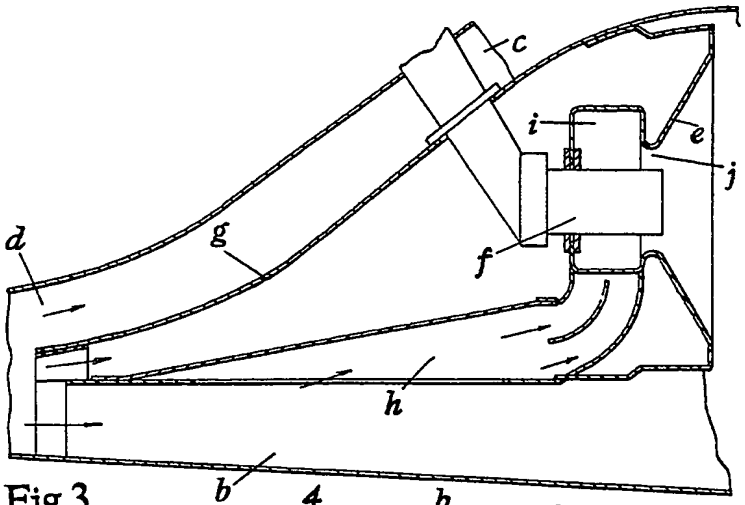

Fig.3

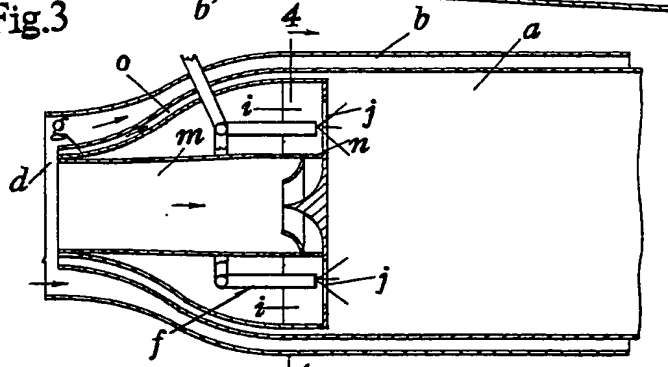

Fig.4

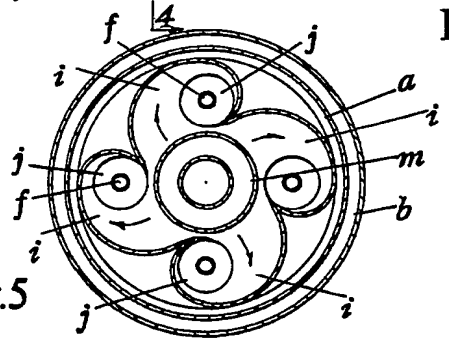

Fig.5

763359 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale Sheets 1 & 2

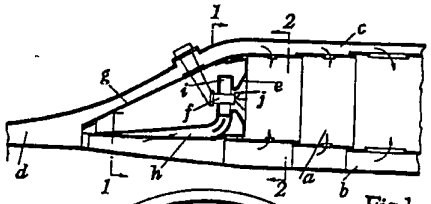

Fig.1

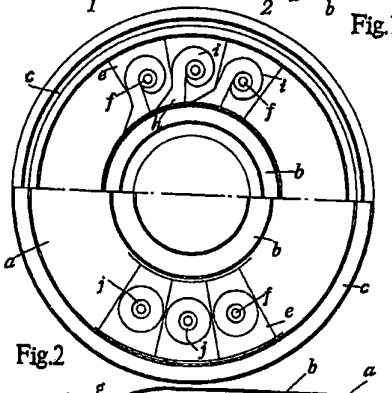

Fig.2

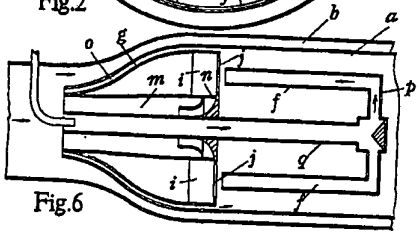

Fig.6

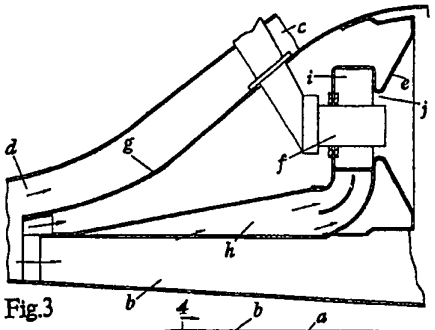

Fig.3

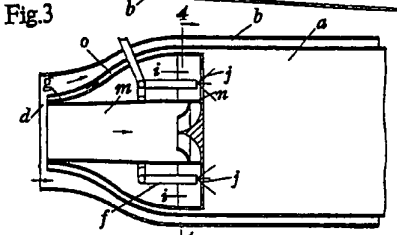

Fig.4

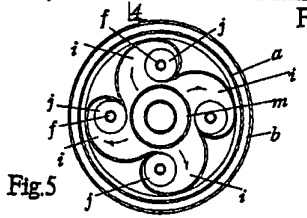

Fig.5